Recommendations for a Department of Energy Nuclear Energy R&D Agenda

Executive Summary

On January 14, 1997, the President requested that his Committee of Advisors on Science and Technology (PCAST) make "recommendations…by October 1, 1997 on how to ensure that the United States has a program that addresses its energy and environmental needs for the next century." In its report, *Federal Energy Research and Development for the Challenges of the Twenty-First Century*,[1] the PCAST Panel stated that "the United States faces major energy-related challenges as it enters the twenty-first century" and links these challenges to national economic and environmental well-being as well as to national security. The Panel concluded that "Fission belongs in the R&D portfolio."

In conjunction with this activity, the DOE Office of Nuclear Energy, Science and Technology, together with seven of the national laboratories, undertook a study to recommend nuclear energy R&D responses to the challenges and recommendations identified by the PCAST Panel. This seven-laboratory study included an analysis of past and present nuclear energy policies, current R&D activities, key issues, and alternative scenarios for domestic and global nuclear energy R&D programs and policies. The results are summarized below.

Nuclear power makes important contributions to our well-being that can be neither ignored nor easily replaced without significant environmental and economic costs, particularly in an energy future dominated by global energy growth but marked by significant uncertainties and potential instabilities. Future reliance on these contributions requires continuing past progress on the issues confronting nuclear power today: safety, waste management, proliferation, and economics. A strong nuclear energy R&D agenda will enable the U.S. government to meet its three primary energy responsibilities: (1) respond to current needs; (2) prepare the country for anticipated future developments; and (3) safeguard the country from unexpected future events.

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[1]The President's Committee of Advisors on Science and Technology, *Federal Energy Research and Development for the Challenges of the Twenty-First Century, Report of the Energy Research and Development Panel*, November 5, 1997.

Today nuclear power:

- Supplies more than 20% of the nation's electricity.

- Reduces total U.S. carbon emissions by 147 million tonnes (MtC) per year, roughly 10% of total U.S. carbon emissions.

- Is a domestically independent and reliable energy source contributing directly to enhanced energy security.

- Is expected to be one of the preferred choices for new electrical generating capacity by many developing nations, particularly in Asia.

The United States' and the world's energy markets are changing. Environmental concerns, such as growing carbon emissions, economic growth of developing countries, and changing demographics, threaten the U.S. energy status quo. Globally, even though the rates of population growth are uncertain, the increase in future electrical energy demand is certain, and keen competition for energy resources is anticipated. There is a clear need to ensure environmentally and economically acceptable energy options in the coming decades. Thus, vital U.S. national interests, including securing the nation's economic well-being and protecting environmental quality, require a blend of energy sources that emit less carbon dioxide and other pollutants than are found in today's energy mix.

This study finds that there are unique challenges associated with nuclear energy and the U.S. role in future nuclear energy activities. These challenges are

- ***Continuing global influence*** *on international policy in such significant areas as nuclear nonproliferation, nuclear safety, and nuclear materials management.*

- ***Maintaining technical competencies*** *to ensure long-term expertise, capabilities, and vital infrastructures as well as leading-edge R&D in nuclear safety, nuclear materials management, fuels, and advanced proliferation-resistant technologies.*

- ***Ensuring a viable nuclear energy option*** *as an effective, economic alternative to address environmental and energy security issues.*

The common denominator in each of these challenges is the need and role for a strong and comprehensive nuclear energy R&D effort by the federal

government. At present the U.S. government is at a crossroads regarding decisions it must make with respect to the future U.S. role involving domestic and global nuclear power because of the successful completion of the Advanced Light Water Reactor Program in fiscal year 1997 and the lack of Congressional support for civilian nuclear energy R&D in fiscal year 1998. Ultimately, the decisions of the U.S. government will have a direct impact on whether these challenges are met.

Recommendations

The following approaches to and areas of nuclear energy R&D are necessary to ensure that the U.S. government continues to wield *global influence* on important nuclear energy issues, maintains its nuclear *technical competencies*, and provides *vital energy options* for the nation's and the world's future energy needs.

(1) Nuclear Energy Research Program. Create a comprehensive research program for nuclear energy, science, and technology to revitalize nuclear energy research at major universities and DOE laboratories. This initiative should be designed to ensure and strengthen the coupling between the creative resources of the universities and the programmatic focus of the national laboratories. Programs and topics might include basic nuclear science and engineering as well as a wide range of applied topics such as fuels and materials, and novel reactor and systems designs.

(2) Nuclear Energy R&D to Meet U.S. Carbon Emissions Reduction Goals. Today's 147 MtC emissions per year avoided by U.S. nuclear power is threatened by the potential for premature plant closures. Pursuit of technologies for both Life Extension and Generation Optimization (LEGO) and next-generation nuclear power would continue current nuclear greenhouse gas emission reductions and enable additional reductions in the future. R&D into monitoring, diagnostics, computing, and materials technologies is needed to help the United States avoid the premature closure and decommissioning of its operating nuclear reactor fleet. Successful development and use of more efficient and cost-effective nuclear power technologies that address the goals of safety, efficient resource utilization, and waste management could also have a major impact on reducing global carbon emissions.

(3) Enhanced Proliferation Resistance. Because of the projected spread and increase of nuclear energy internationally and future uncertainties associated with world events, it is prudent for the United States to reinvigorate efforts to explore more proliferation-resistant forms of nuclear energy. A broad effort including systems studies to identify more advanced proliferation-resistant technologies is needed.

(4) Cooperative Development of High-Efficiency Nuclear Fuel with industry of improved fuels with extended burnup, demonstrated safety margins, and capacity to enable longer operating cycles may reduce the government's costs for spent fuel disposition and improve nuclear plant operating efficiencies.

(5) International Nuclear Cooperation will allow the United States to continue its strategy of technology and safety improvements, influencing worldwide nuclear development, and initiating international research. Nuclear safety and nuclear nonproliferation have been and are two key elements of U.S. international nuclear policy, and global collaboration is a necessity in order to preserve U.S. influence within the international nuclear community.

These recommendations are intended to complement those from the PCAST study. They represent a beginning step to help ensure the health of the United States nuclear energy enterprise and expertise base, as well as to enhance the credibility and leadership role of the United States in the international nuclear energy arena.